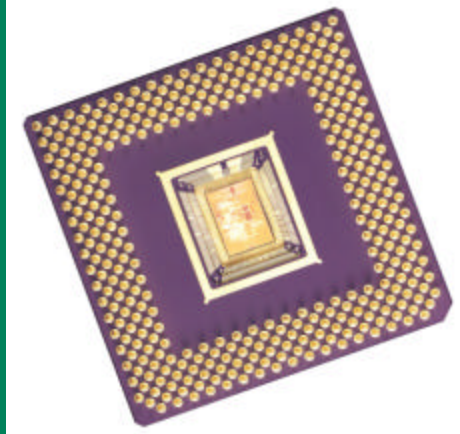

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VIA Cyrix® Processor Technology Overview

C.J. Holthaus

Centaur Technology

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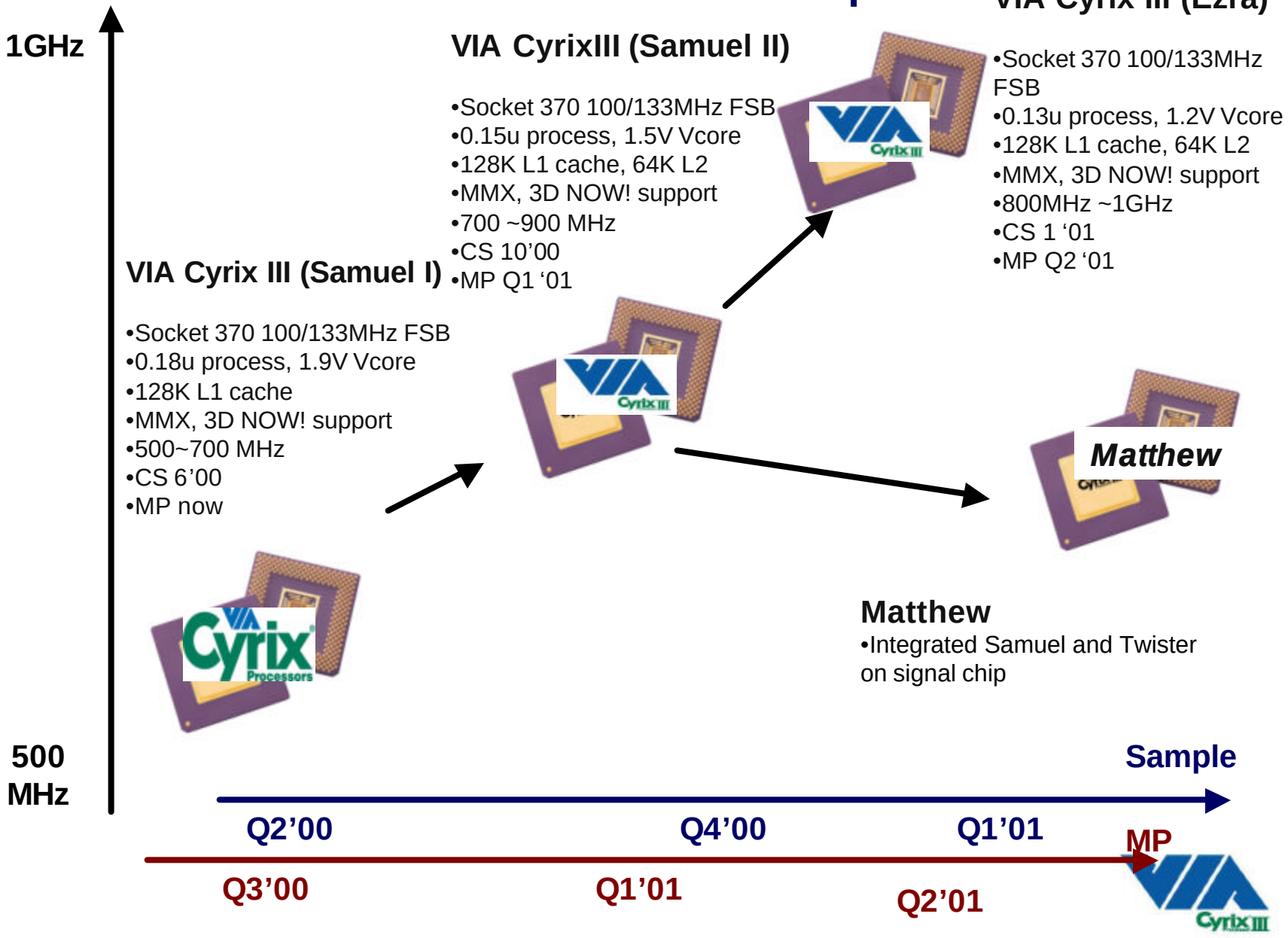
VIA Processor Schedules/Spec



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VIA Processor Feature Comparison

-- Full Socket370 support

	Samuel I	Samuel II	Ezra
Package	CPGA	CPGA//EBGA/uPGA	CPGA/EBGA/uPGA
Footprint	Socket 370	Socket 370	Socket 370
Bus Speed	100/133MHz	100/133MHz	100/133MHz
Multimedia	MMX™,3DNow!	MMX™,3DNow!	MMX™,3DNow!
Speed	500~700MHz	700~900MHz	800MHz~1GHz
IC Process	0.18	0.15	0.13
Voltage	1.9/2.0V	1.5V	1.2V
L1 Cache	128k	128k	128k
L2 Cache	0k	64k	64k
Pipeline Stages	12	12	12

Samuel I --> Samuel II Enhancement

Office Applications, Winstone: +15%

3D Applications: +20~25%

Power Consumption: -40%

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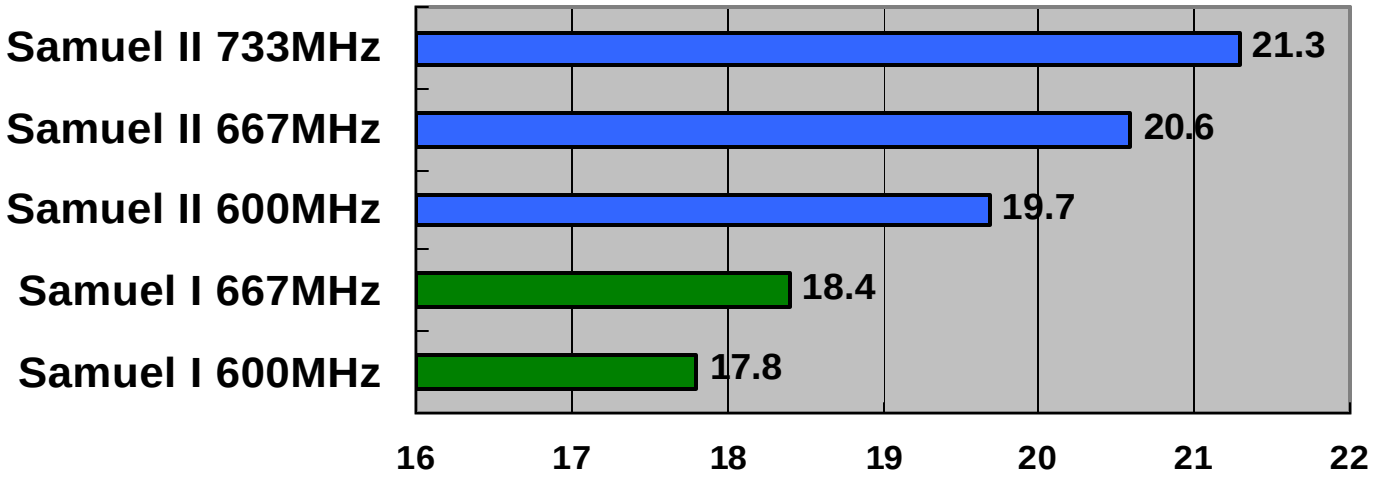
Performance --Winstone '99



Value-line System Configuration:

CPU	: Samuel I, Samuel II Various speeds@133MH FSB (733C5B is estimated)
M/B	: VIA PLE133 motherboard
VGA	: On Chip VGA, 8MB shared Memory, 1024x768x16bit
DRAM	: KingMax 64MBx1 PC-133
HDD	: IBM DJNA-371350 13.5GB UDMA66
O.S.	: Windows 98 SE

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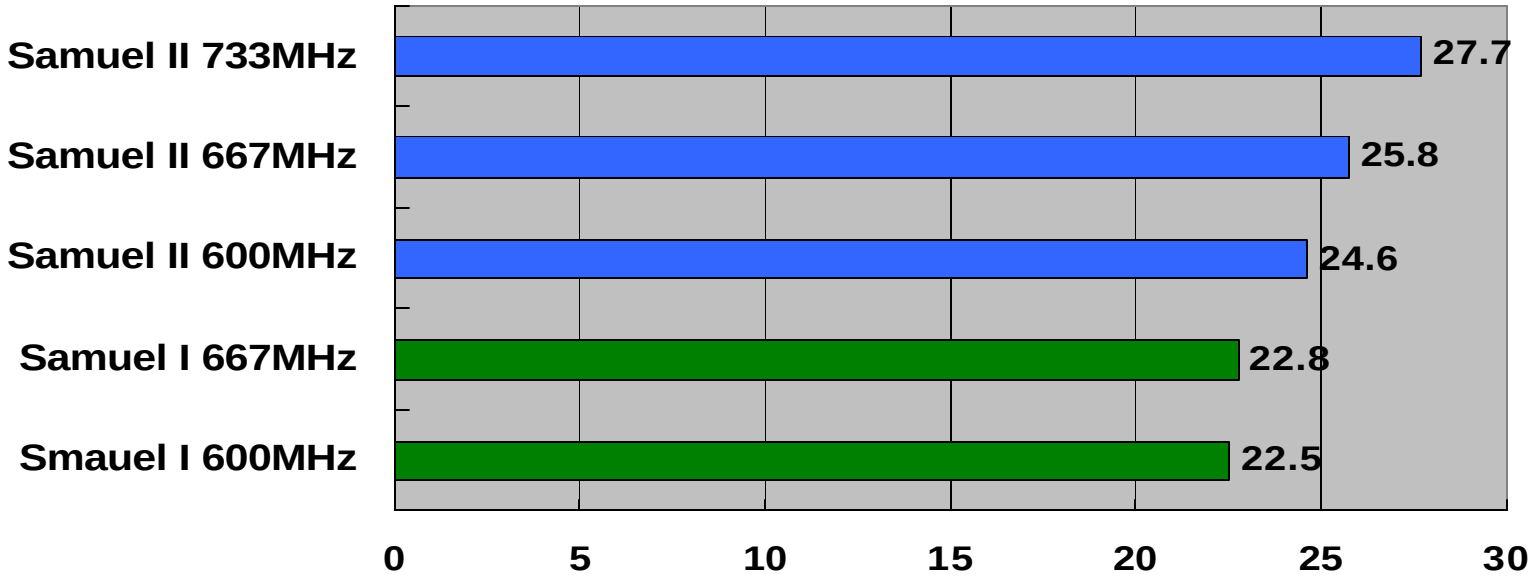
Performance --Winstone '99



Performance-line System Configuration:

CPU	: Samuel I, Samuel II Various speeds@133MH FSB
M/B	: VIA Apollo 133A chipset motherboard
VGA	: ASUS 3800 TNT2 Ultra
DRAM	: LGS 128MBx1 PC-133
HDD	: IBM DJNA-371350 13.5GB UDMA66
O.S.	: Windows 98 SE

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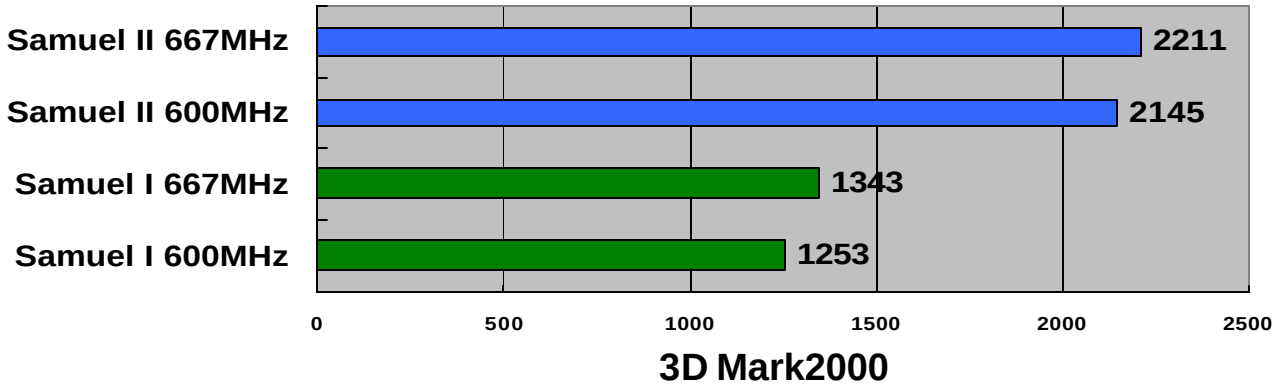
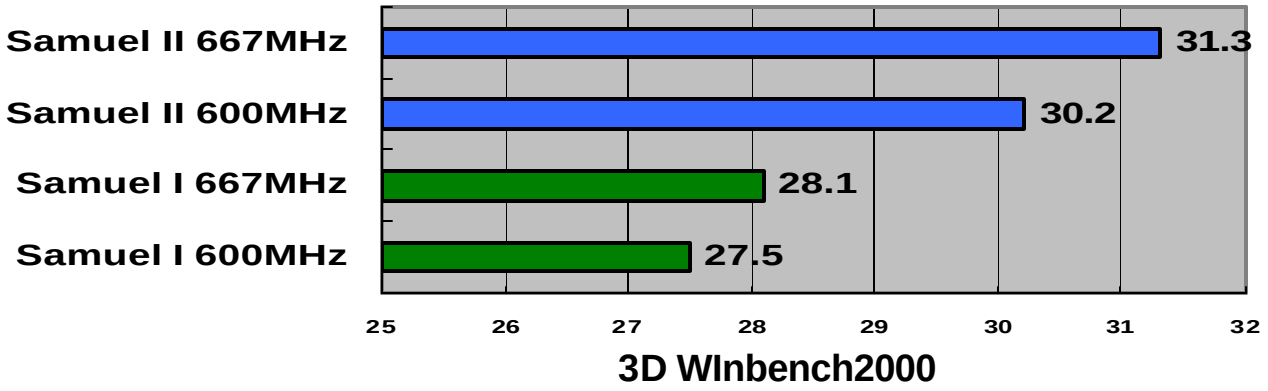
Performance -- 3D Mark 2000, 3D Winbench 2000





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O.S.	: Windows 98 SE

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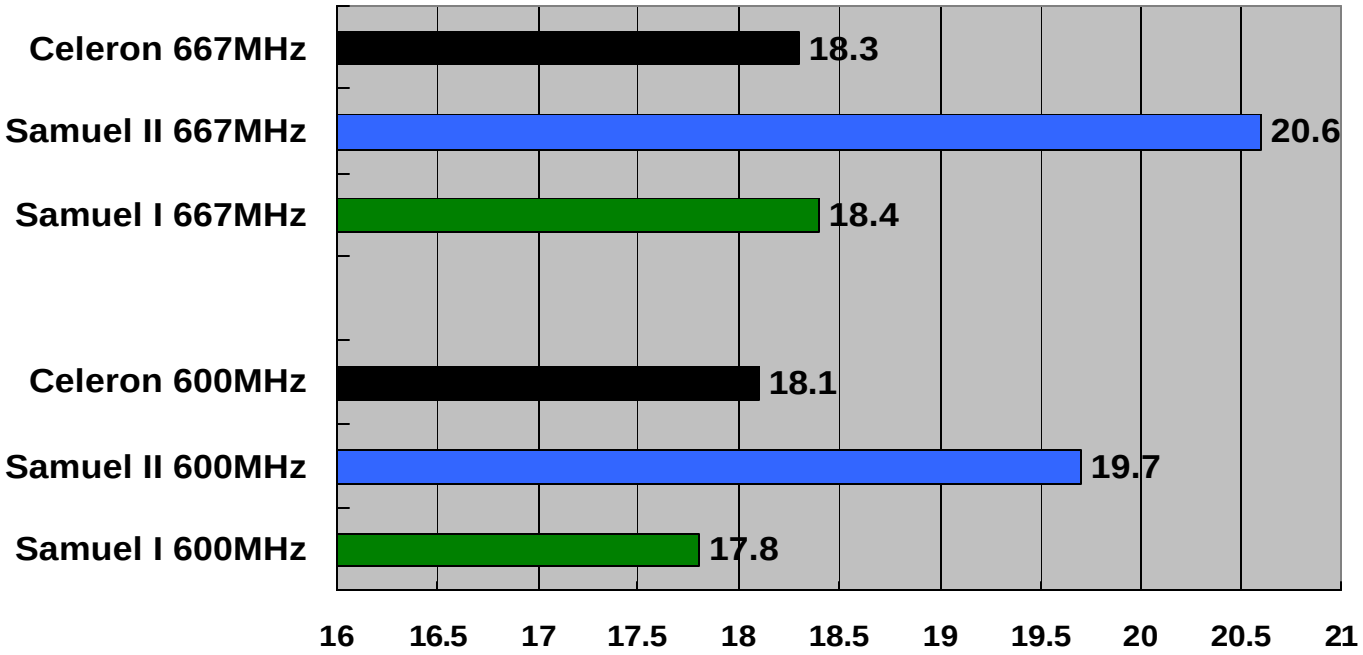
Performance Comparison--Winstone '99



Value-line System Configuration:

CPU	: Samuel I, Samuel II, Celeron 600,667MHz
M/B	: VIA PLE133 motherboard
VGA	: On Chip VGA, 8MB shared Memory, 1024x768x16bit
DRAM	: KingMax 64MBx1 PC-133
HDD	: IBM DJNA-371350 13.5GB UDMA66
O.S.	: Windows 98 SE

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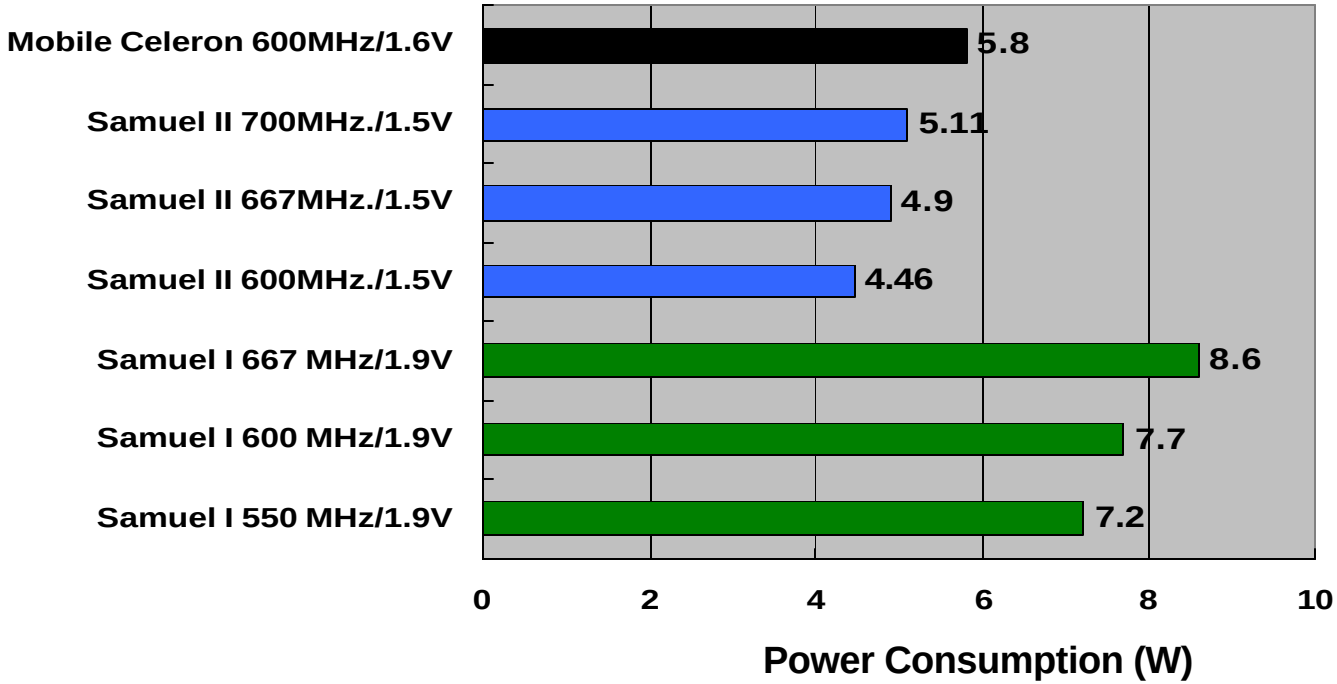
Power Consumption



***Typical power consumption is the average power consumed while running Winstone '99 on Win 98SE**

•Samuel II Power 30% lower than Mobile Celeron!!

Value-line System Configuration:

CPU	: Samuel I, Samuel II Various speeds , Mobile Celeron 600MHz
M/B	: VIA PLE133 motherboard
VGA	: On Chip VGA, 8MB shared Memory, 1024x768x16bit
DRAM	: KingMax 64MBx1 PC-133
HDD	: IBM DJNA-371350 13.5GB UDMA66
O.S.	: Windows 98 SE

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VIA Processor Packaging Comparison

	CPGA/PPGA	EBGA	uPGA
Dimension	49.53x49.53x6.13 mm3	35x35x1.525 mm3	34.1x28.27xTBD mm3
Pin count	370	368	495
Pin pitch	1.8	1.27	1.27
Pinout/Ballout	Available	Available	Available
Outline drawing	Available	Available	12/E
Power data	Available	Available	Available
Thermal data	Available	12/E	Jan/M

Schedules--

EBGA:

Sample ready: Feb'01

MP : Apr'01

uPGA:

Sample ready: Mar '01

MP : Jun '01

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Power Saving with LongHaul™ Technology

- **Software application, no hardware changes required.**
- **Automatic CPU speed switch according to system loading or Manual control for professional users**
- **Satisfies both power and normal users with different CPU power usage.**
- **Supports ACPI S1/S2/S3/S4/S5 power management**
- **Supports mobile products with AC adapter detection, automatically switches to max speed while AC adapter plugged in**
- **Does not interrupt MODEM data transfer**

Samuel I LongHaul-- Available now, can reduce frequency automatically/manually.

Samuel II LongHaul-- Available Q1 '01, can reduce both frequency AND voltage, results in dramatic reduction in power!

- Samuel 2 at 600 MHz 1.5V consumes 800 mW when idle in Windows 98. Using LongHaul to lower the MHz to 300 MHz, the CPU would consume 600 mW @ 1.5V. Using LongHaul to adjust the voltage down to 1.2V, the CPU would consume 275 mW, a 65% power savings.

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Technical Documents Available

- **Datasheet**
- **BIOS Writer Guide**
- **Motherboard Design Guide**
- **Thermal/power design guide**
- **EBGA Ballout/Packaging Specification**
- **uPGA pinout**

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VIA Cyrix? III Processor Highlights

- Low Power Consumption
- Plug-in Socket 370 Compatibility
- Full x86 & Internet Software Compatibility
- Dependable Performance
- World Class Quality & Reliability
- Compelling Value

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Samuel Family Features

- **Socket370 compatible**
  - 100 & 133-MHz socket 370 bus (actually continuously variable)
  - BSEL[1] driven to indicate 100 or 133 MHz bus.
  - We ignore external settings of BSELs
- **Locked (fused) clock multiplier**
  - We could run with unfused multiplier (fuse/pin option)
  - Software (BIOS) can override fused multiplier
  - This allows concept of changing multiplier based on usage.
  - Used by LongHaul™ software
- **Compatible VID pins control voltage**
  - Special Samuel 2 has “soft VID pins” that software can control
- **Some bus features missing (JTAG, APIC, etc.).**
  - Not relevant to value PC market.

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Samuel Family Features

- **Minimal BIOS Changes Required**
  - Compatible memory trait range registers (MTRRs)
  - Many MSRs the same (e.g. EBL_CR_POWERON
- **Highly Compatible Programming interface**
  - Only differences are esoteric things known not to matter
  - Or, explicitly identified “optional” features
  - Or, unavoidable vendor string issues (negligible)
- **Some “CPUID-Optional” Functions Missing**
  - - Identified via CPUID instruction
  - - No 4-MB pages, no CMOV, etc.
- **Small Die Sizes**
- **Supports Low-Cost Packaging (wire-bond, no capicitors)**
- **Low Power Consumption**

VIA Cyrix III

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Low Power Socket370 Processor

- **Small die-size that ensures**
  - **Easier thermal management due to low heat dissipation**
  - **Longer notebook battery life**
- **Enables flexible desktop & mobile device designs**
  - **Fanless, noise-free, always-on Information PC and IA designs**
  - **Value and ultra-slim notebooks**
    - **Future Sub 4W Low Power and BGA versions with LongHaul? software Power Management technology**

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Power Dissipation

Many Misleading Claims & Numbers in Industry!

- Makes performance benchmarks look honest!
  (hidden benchmarks, hidden workloads, hidden #s, biased weighting, new metrics, etc.)

Our Philosophy: Same as for Performance

- Real application benchmarks
- Meaningful to our target customers
- Developed by independent people
- Publicly available
- Realistic systems
- Thus, we only show real workload numbers

Industry Challenge: *Meaningful Comparisons*

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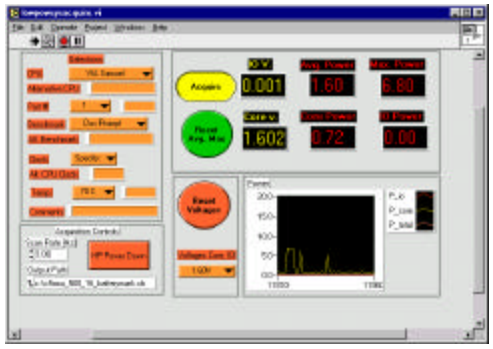
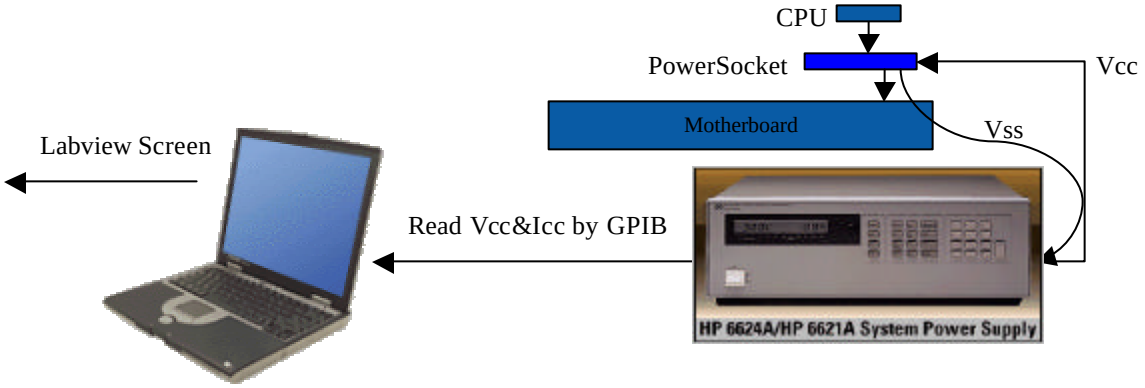
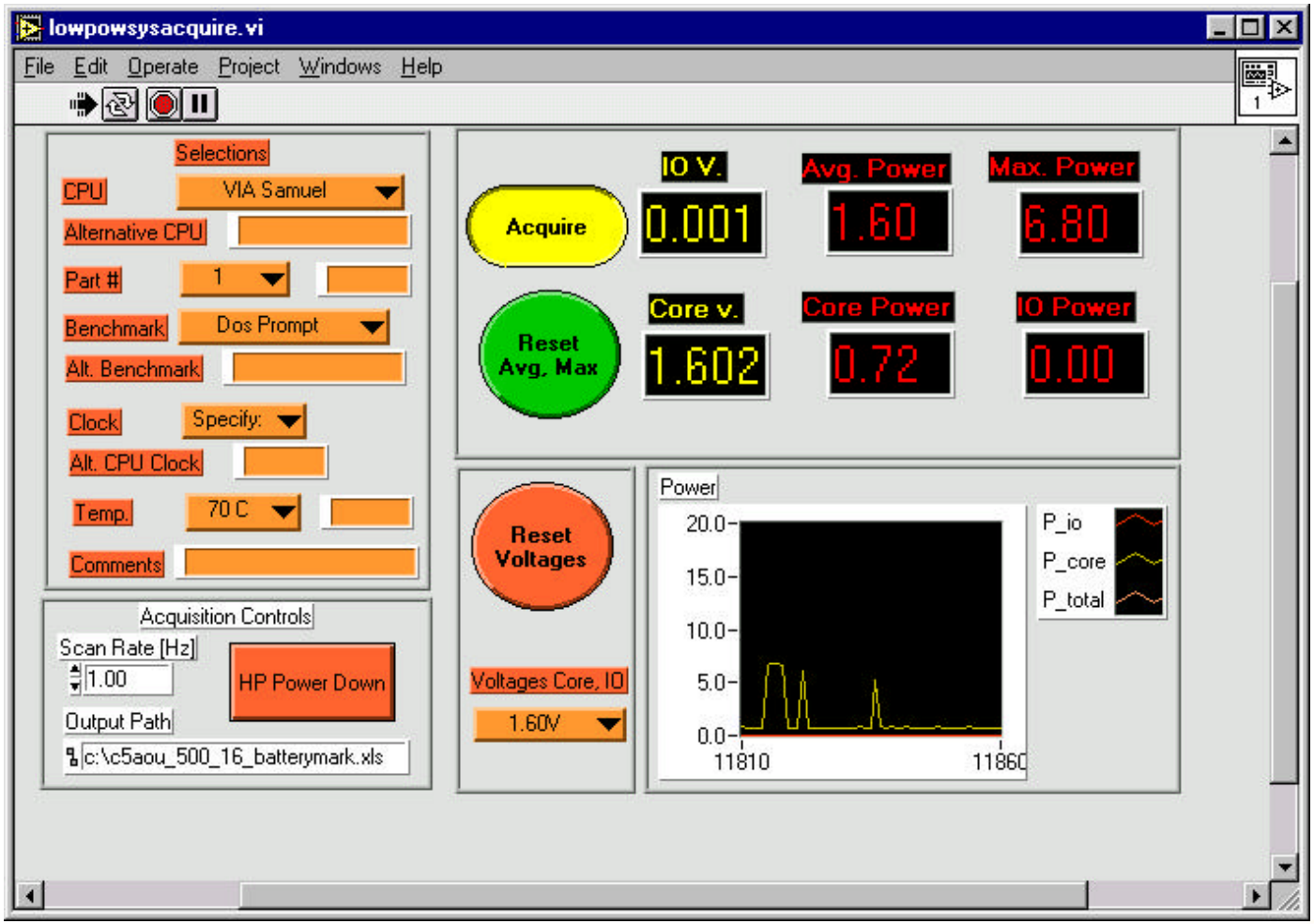
Dynamic Power Analysis

- **Power measurement over time**
- **Tools**
  - National Instruments Labview
  - National Instruments GPIB card
  - HP DC PowerSupply with GPIB output
  - Socket370 PCB with Vcc and Vss isolated from other pins





Labview Virtual Instrument Panel



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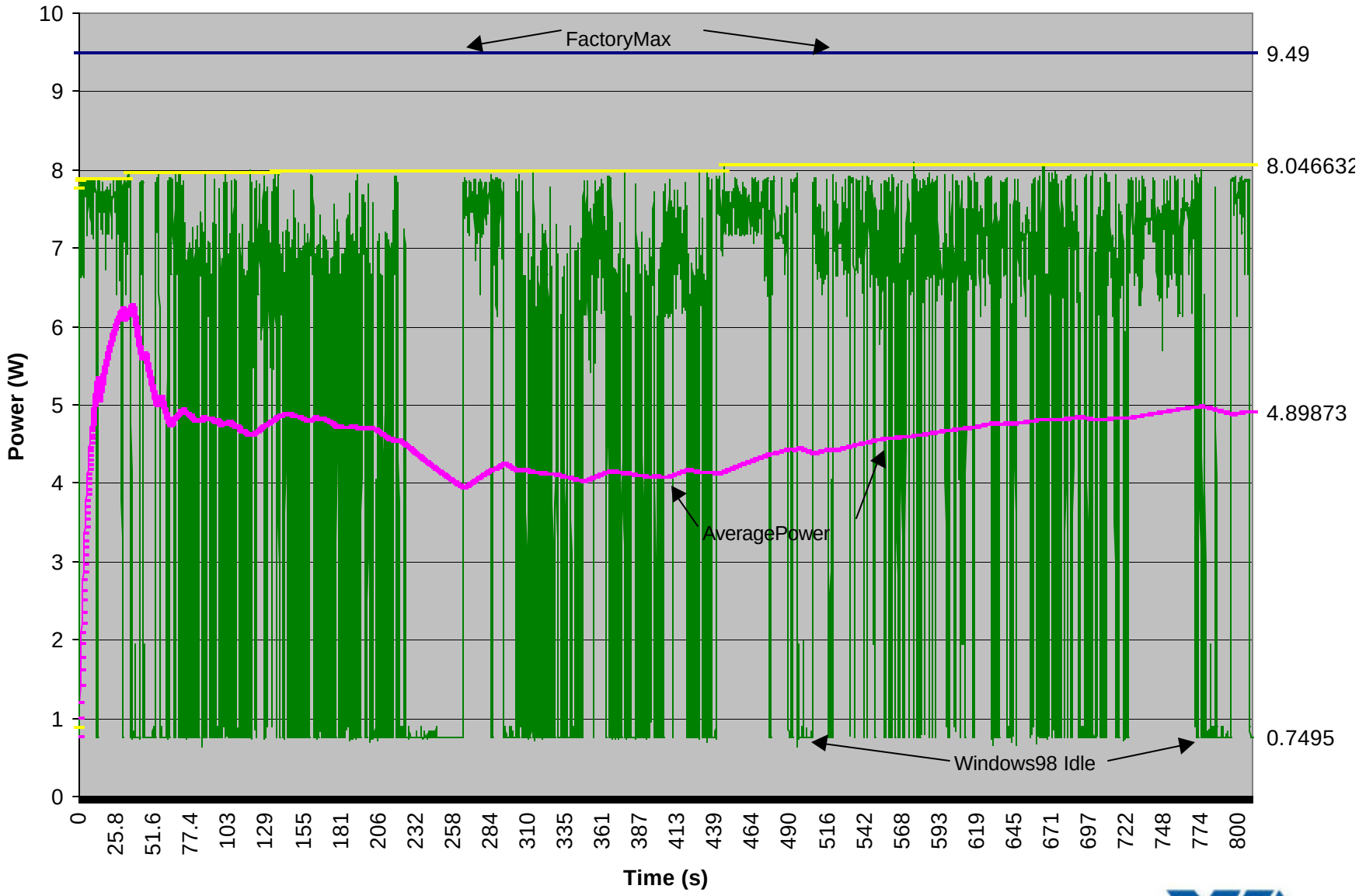
VIA Samuel 2 700 MHz 1.5V



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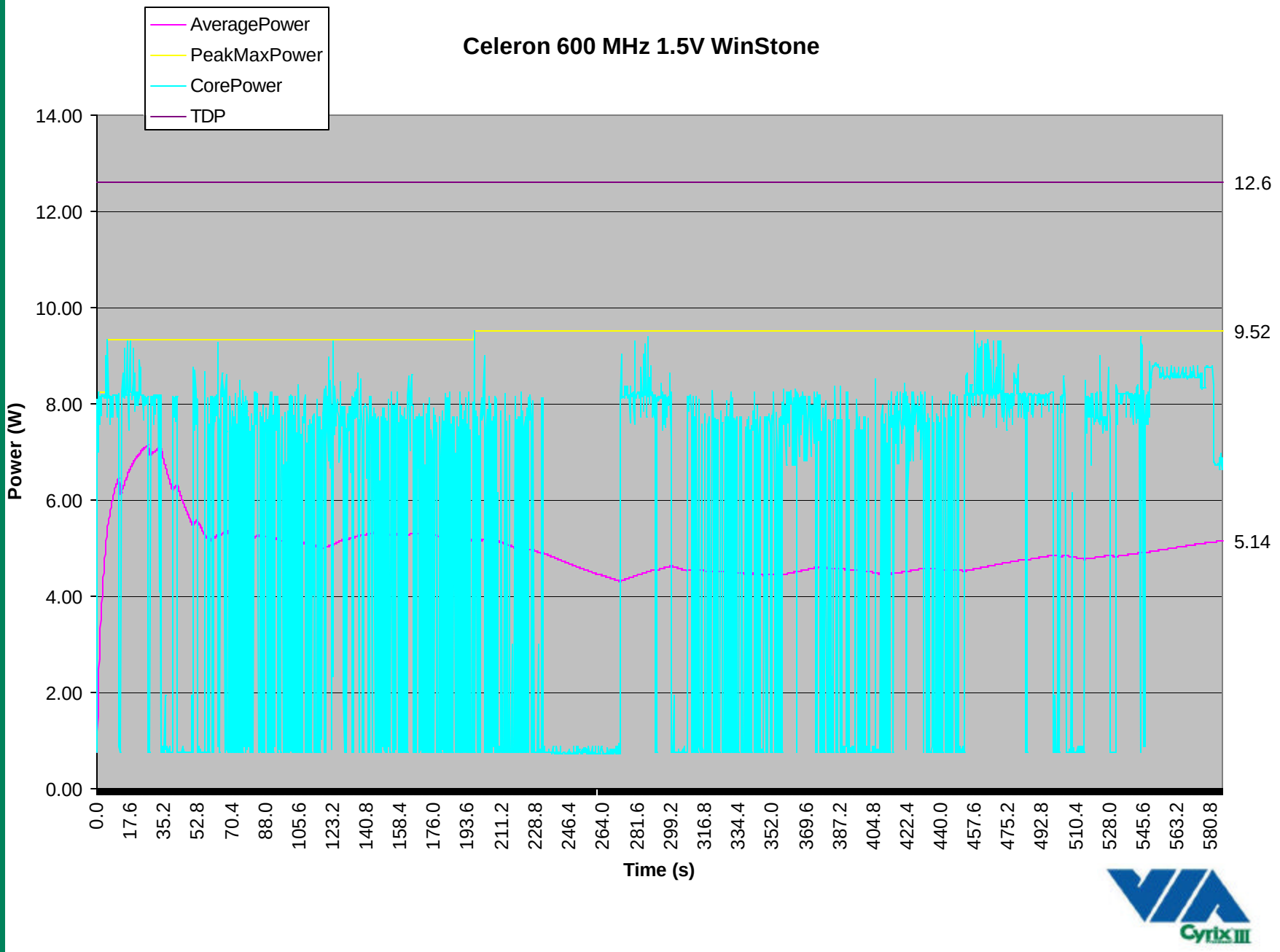

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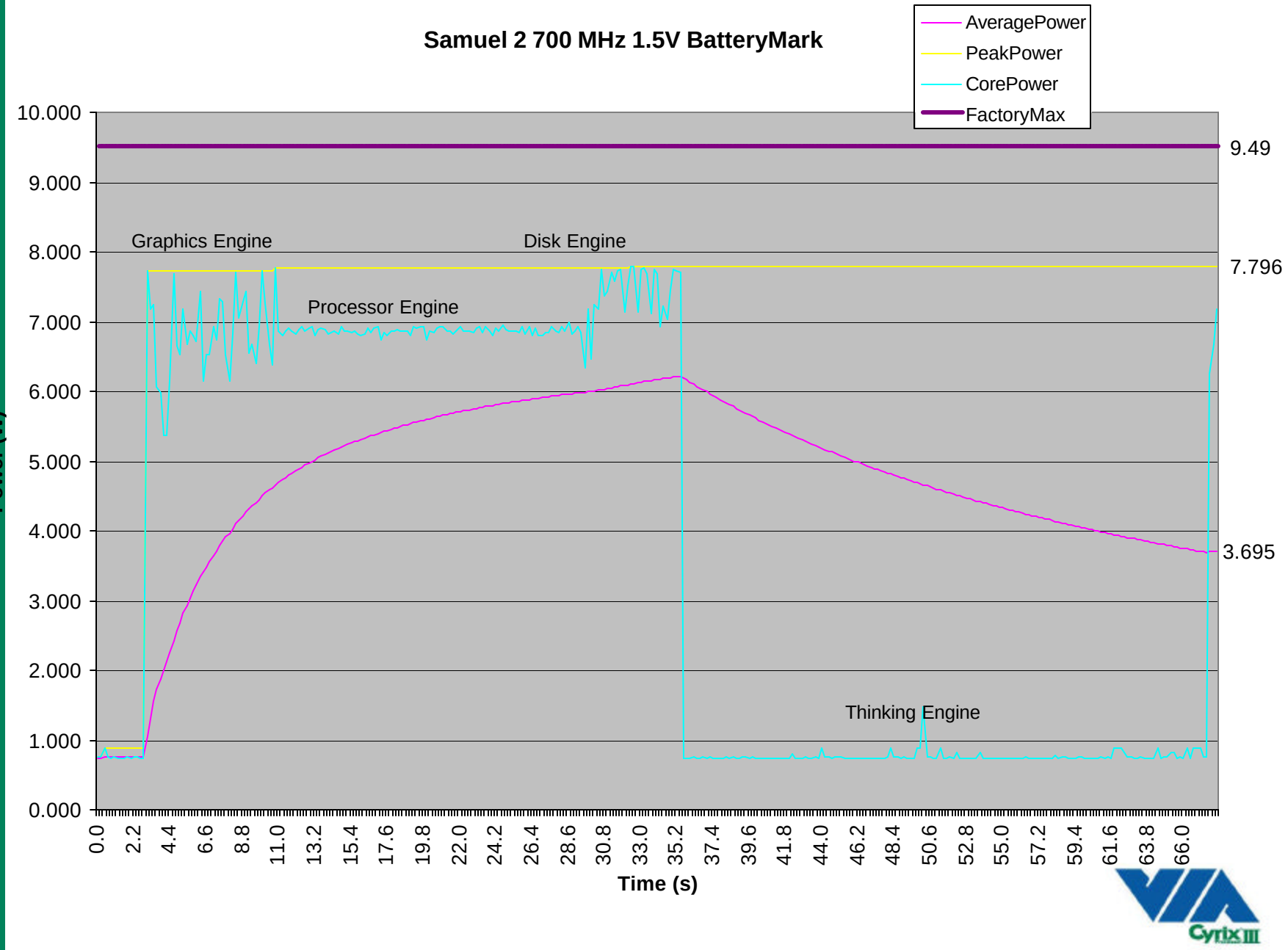

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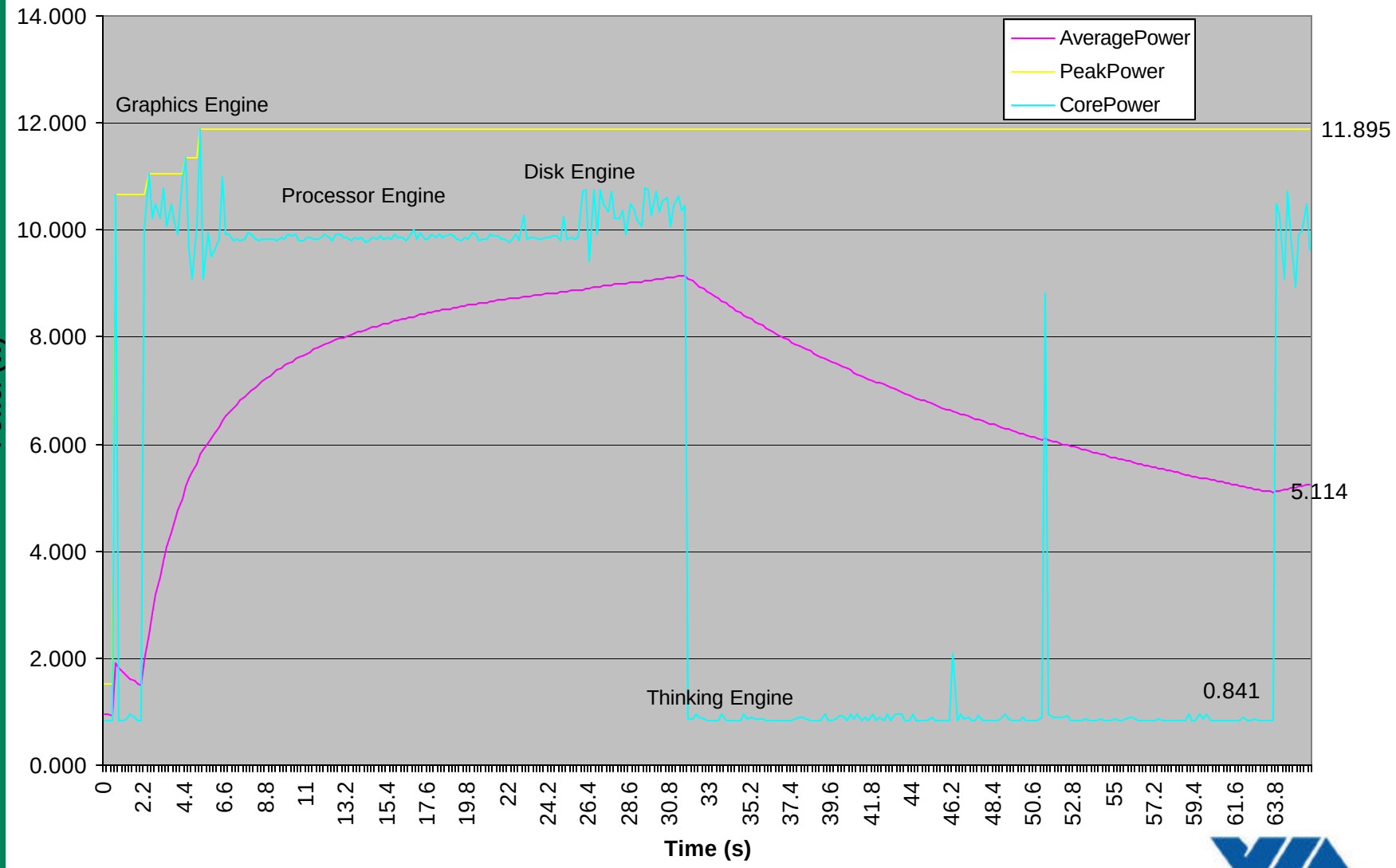
Mobile Celeron 700 MHz 1.60V BatteryMark



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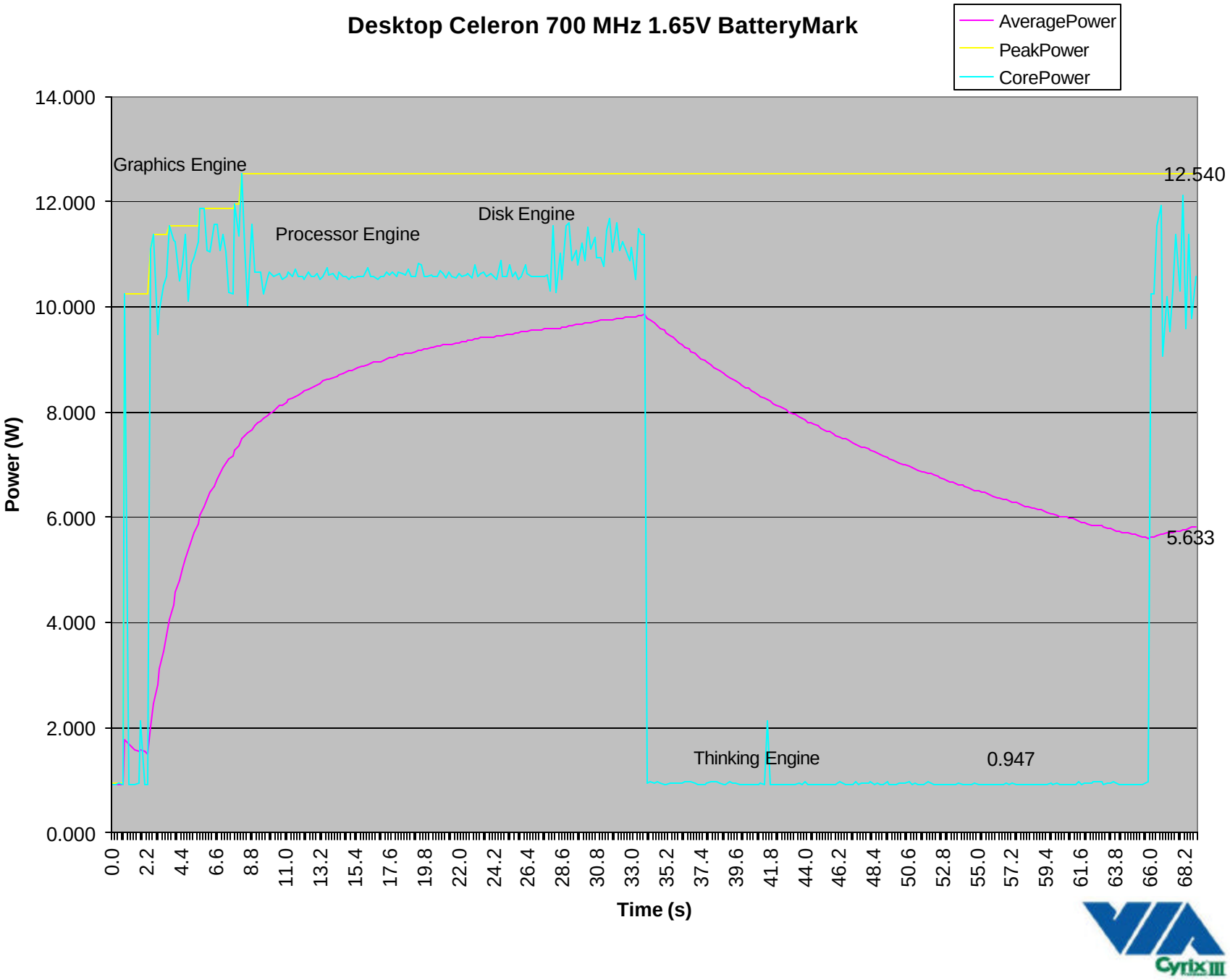

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Thermal Design Power

- FactoryMax
  - Highest wattage possible from the factory when executing the worst case instruction sequence designed to consume the most power. “Thermal Virus”
  - Specified at 70C and nominal voltage
  - Factory will reject parts that exceed these specified values.
  - *Thermal solutions should be designed to FactoryMax.*
  - Synthetic program that consumes the most power (MAXPOW.EXE) available
- AveragePower
  - Average power consumed while running WinStone99.
  - AKA **Typical** power.
  - Mobile note:
    - Power management features built into Windows 98SE keep the processor in a low power state when idle. The mobile PC’s battery life is proportional to the Windows 98SE idle state. This assumes the user does little work with the CPU. Moderate to heavy usage profiles should consider the power consumed while running WinStone 99 to estimate battery life.

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More Thermal Design Power

	Typical[2]	Maximum[3]		Unit
Power Management State		AverageMax[4]	FactoryMax[5]	
Normal[1]				
VIA Cyrix III 600 MHz	7.70	13.1	14.60	W
VIA Samuel 2 700 MHz	5.11	8.69	9.49	
Stop Grant				
VIA Cyrix III 600 MHz	-	1.46	1.71	W
VIA Samuel 2 700 MHz	-	0.87	1.09	
Sleep				
VIA Cyrix III 600 MHz	-	1.27	1.45	W
VIA Samuel 2 700 MHz	-	0.86	1.09	
Deep Sleep				
VIA Cyrix III 600 MHz	-	0.22	0.51	W
VIA Samuel 2 700 MHz		0.40	0.72	

- 1. The normal power state is the common operating mode of the CPU.
- 2. Typical power is the average power consumed while running WinStone99 on Win98SE.
- 3. Maximum power is generated from running the worst case instruction sequence that consumes the most power. Specified at 70C and 1.9V.
- 4. AverageMax is average value of all parts while running the worst case instruction sequence. Not 100% guaranteed or tested.
- 5. FactoryMax is the factory limit for power consumption while running the worst case instruction sequence at 70C. Factory will reject parts that exceed these specified values. Thermal solutions should be designed to FactoryMax.

Hardware Design Guidelines

- No Jumpers needed
  - Clock Multiplier Locked
  - CPU indicates 100 MHz or 133 MHz FSB to clock chip for plug and play operation
    - CPU can run at any intermediate frequency
- VRM (Voltage Regulator Module) should provide the following processor core voltages.

	Core
VIA Cyrix III	1.9V
VIA Samuel 2	1.5V
VIA Ezra	1.2V

- Bus termination resistors required on motherboard

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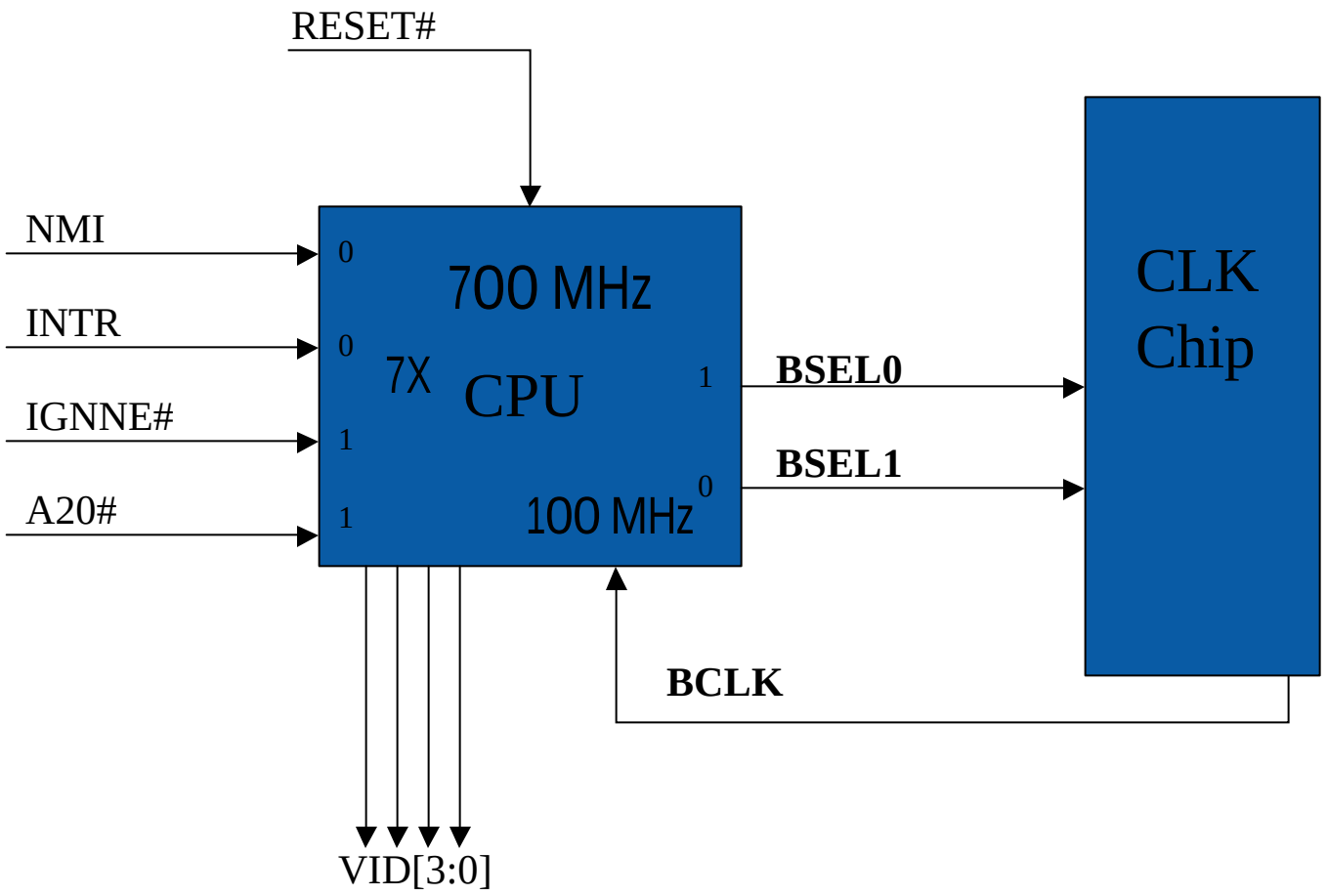
Socket370 Hardware Setup



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BIOS Design Guidelines

- **Most BIOS's already allow a VIA Cyrix III to boot.**
  - Can boot in alien system (e.g. Dell OptiPlex)
  - AMI BIOS is exception. CPU must be recognized else L1 cache is disabled.
- **BIOS modification only necessary for CPU recognition.**
  - Display marketing name, MHz, clock multiplier, and FSB
  - **No cache initialization required**
- Use LongHaul™ for jumperless clock multiplier adjustment

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LongHaul™ Details

- Software programmable HW features
  - Adjusts clock multiplier
  - Dynamically changes VID encoding to VRM
- Steps:
  - Program desired multiplier or VID bits
  - Activate enable bits
  - Disable interrupts for 1ms
  - Put CPU in to AutoHALT
  - Once resumed, CPU runs at new voltage or clock multiplier

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Identification

- CPUID instruction **(opcode 0x0FA2).**
  - **Function 0**
  - Input: EAX=0
  - Output:
    - EAX=1
    - EBX=0x746E6543 "tneC"
    - EDX=0x48727561 "Hrua"
    - ECX=0x736C7561 "slua"
  - Vendor ID string(EBX:EDX:ECX) is "CentaurHauls".

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Identification Continued

- CPUID instruction **(opcode 0x0FA2).**
  - **Function 1**
  - Input: EAX=1
  - Output:
    - EAX[3:0]=Stepping
    - EAX[7:4]=Model
    - EAX[11:8]=Family
    - EDX=Feature Flags
- Specifically,

	Family	**Model**	**Stepping**
VIA Cyrix III	**6**	6	0-F
VIA Samuel 2	6	7	0-7
VIA Ezra	6	7	8-F

VIA Cyrix III

Identification Continued

- Feature Flags
  - Software should look at these bits to determine specific HW features
  - We indicate:
    - integrated FPU
    - MMX™
    - MTRR
    - Time Stamp Counter
    - Machine Specific Registers (MSR's)
    - Global Pages
    - CMPXCHG8B*
  - No support indicated for features not used in value PC market
    - APIC, 4 MB pages, 36 bit addressing, etc.

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Technical Documents Available

- **Datasheet**
- **BIOS Writer Guide**
- **Motherboard Design Guide**
- **Thermal/power design guide**
- **EBGA Ballout/Packaging Specification**
- **uPGA pinout**

  - **See a VIA Sales Representative Today**